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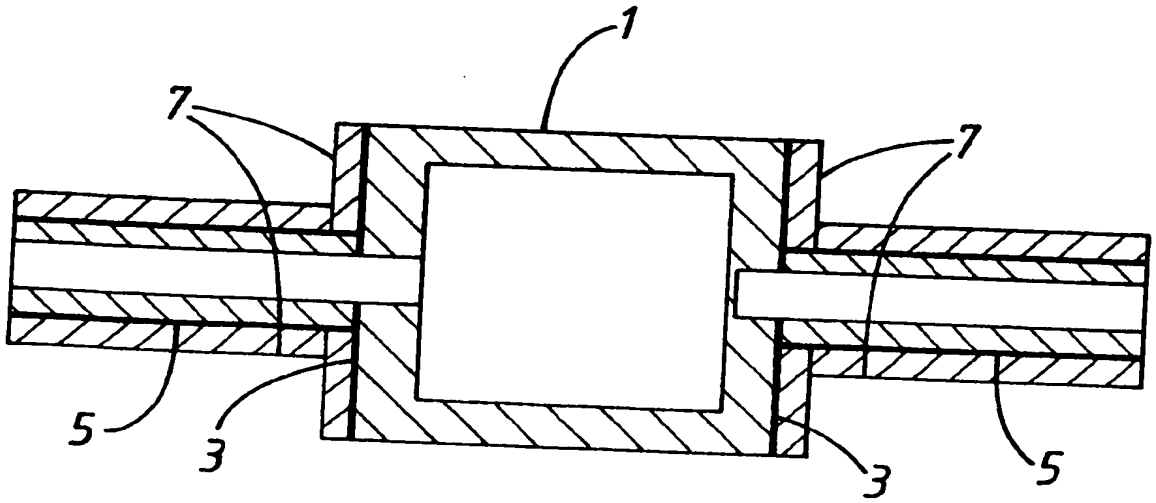
(54) **Ceramic metal halide arc lamp and method of making it**

(57) A ceramic metal halide arc lamp comprises an arc tube (1), a metal halide filling and a coating (7) of zirconium oxide on at least part of the arc tube (1).

The invention also includes a method of making such an arc lamp.

FIG. 1



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Description

This invention relates to a ceramic metal halide arc lamp and to a method of making it.

With ceramic metal halide lamps, a problem exists in providing a suitable colour control and the prevention of wall erosion, voltage rise and short lifetimes. The biggest problem relating to ceramic metal halide (CMH) lamps relates to the stability of the colour temperature of the lamp. In order to provide for this control of the colour temperature in a stable way, it is necessary to increase the vapour pressure of the metal halide in the arc plasma.

A number of ways have been tried to achieve this increase, but while the increase in the vapour pressure which resulted, provided the stability of the colour temperature, all of the previous proposals resulted in significant disadvantages, giving rise to unacceptable lifetimes for the lamp. One proposed method was to increase the amount of metal halide in the arc tube. This unfortunately resulted in increase in the wall erosion of the arc tube which significantly shortened the life of the lamp.

The invention therefore seeks to provide a ceramic metal halide arc lamp and a method of producing it in which it is possible to increase the vapour pressure of the metal halide in the arc plasma during operation while substantially avoiding the above-mentioned disadvantages of currently proposed solutions.

According to a first aspect of the invention a ceramic metal halide arc lamp comprises an arc tube, a metal halide fill and a coating of zirconium oxide on at least part of the arc tube.

Preferably the ceramic used is alumina and the zirconium oxide coating is applied at least to the end plug of the arc tube. The zirconium oxide coating may also be applied to the legs of the arc tube.

According to a second aspect of the invention, a method of making a ceramic metal halide lamp comprises forming a ceramic arc tube and dipping at least part of the arc tube in a zirconium oxide suspension to provide a coating on at least part of the arc tube.

Preferably it is the end plug of the arc tube which is dipped in the zirconium oxide suspension. If desired, both the end plug and the legs of the arc tube can be dipped in the zirconium oxide suspension.

After dipping, the arc tube may be dried out and placed in a furnace at between 400 and 500°C for between 15 and 30 minutes.

The invention will now be described in greater detail, by way of example, with reference to the drawings, in which:-

FIGURE 1 is a schematic sectional view of an alumina arc tube to which a zirconium oxide coating has been applied to the end plug and legs of the arc tube in accordance with one embodiment of the invention.

FIGURE 2 is a graph of first t st results on comparison between coated and uncoated arc tubes;

FIGURES 3 and 4 are graphs of second test results on comparison between coated and uncoated arc tubes; and

FIGURE 5 is a table showing measured parameters of a hundred hour test on lamps built in a production line environment.

Referring firstly to Figure 1 of the drawings, there is shown an alumina arc tube 1 having end plugs 3 at each end and legs 5 extending outwardly from the end plugs 3. The arc tube, as can be seen, is provided with a zirconium oxide (Z_rO_2) coating 7 on the exterior of the end plugs 3 and around the legs 5.

In order to achieve the zirconium oxide coating, both ends of the arc tube are dipped into a suspension of the zirconium oxide so that the zirconium oxide is deposited on the end plugs 3 and around the legs 5. In order to get a sufficient thickness of coating, the arc tube may need to be dipped twice.

Once the coating has been carried out, the arc tube is dried off and then is placed in a furnace at a temperature of between 400 and 500°C (in particular 460°C) for a period of between 15 and 30 minutes (preferably 20 minutes). The arc tube is then ready for assembly including the insertion of the fill in known manner.

Tests of the lamp have shown that the zirconium oxide coating reflects back infra-red rays emitted by the arc plasma back into the plasma instead of allowing it to pass out through the end plug and the leg area. This has the effect of increasing the temperature of the inner surface of the arc tube and as a result of this increase in temperature, the vapour pressure of the metal halide in the arc plasma is increased without the need to increase the amount of metal halide in the fill.

Thus the vapour pressure increases sufficiently to provide acceptable control of the colour temperature of the lamp without the necessity of taking any action which would cause a reduction in the life of the lamp.

Tests were carried out on a trial lamp initially uncoated, its colour-power curve being taken for the uncoated arc tube. The arc tube was thereafter coated on its ends with a zirconium oxide film. The arc tube was re-assembled and run for seven hours and the colour power curve was again measured.

Figure 2 shows the results of this test in which the graph 20 represents the uncoated lamp and the graph 21 represents the coated lamp. From this it will be seen that the colour power curve of the bare arc tube did not reach a minimum even at 90 watts while that of the coated arc tube shows a clear minimum at around 80 watts. This indicates that the arc tube temperature was higher and better colour control was possible.

A second test was then carried out with bare and coated arc tubes. In this case th zirconium oxide coating was baked in a furnace at 460°C for twenty minutes. This baking of the coating avoids the so-called oxygen

defect in which the zirconium oxide is converted into pure zirconium.

Figures 3 and 4 show graphs of the comparison between the coated and uncoated lamps on the basis of the colour power curve (Figure 3) and the lumen output (Figure 4).

Further tests were then carried out on a batch of eight coated lamps produced in a production line environment and the various parameters of the lamps were measured after a hundred hours. The results of the tests appear in the table of Figure 5.

It will be appreciated that the above described lamp has been coated both on the end plugs and the legs which is believed to provide the best result.

However, it is to be understood that the invention is not limited to this version and substantial gains may be achieved where only the end plugs are coated.

From the above it will be seen that the invention provides an improvement to ceramic metal halide lamps which enables good colour control while maintaining an acceptable life of the lamp.

As will be seen, two tests were made with the arc tubes in vertical and horizontal positions.

Claims

1. A ceramic metal halide arc lamp comprising an arc tube, a metal halide fill and a coating of zirconium oxide on at least part of the arc tube.

2. A lamp as claimed in claim 1, wherein the ceramic is alumina.

3. A lamp as claimed in claim 1 or 2, wherein the zirconium oxide coating is applied to the end plug of the arc tube.

4. A lamp as claimed in claim 3, wherein the zirconium oxide coating is also applied to the legs of the arc tube.

5. A lamp as claimed in any one of claims 1 to 4, wherein the zirconium oxide coating is applied to the arc tube by dipping the arc tube into a suspension of zirconium oxide.

6. A method of making a ceramic metal halide lamp comprising forming a ceramic arc tube and dipping at least part of the arc tube in a zirconium oxide suspension to provide a coating on at least part of the arc tube.

7. A method as claimed in claim 6, wherein the arc tube is formed of alumina.

8. A method as claimed in claim 6 or 7, wherein the end plug of the arc tube is dipped in the zirconium oxide suspension.

9. A method as claimed in claim 8, wherein both the end plug and the legs of the arc tube were dipped in the zirconium oxide suspension.

10. A method as claimed in any one of claims 6 to 9, wherein the arc tube is dipped twice in the zirconium oxide suspension.

11. A method as claimed in any one of claims 6 to 10, wherein the arc tube is dried out after dipping and placed in a furnace at between 400 and 500°C for between 15 and 30 minutes.

12. A method as claimed in claim 11 wherein the arc tube is placed in the furnace at 460°C for 20 minutes.

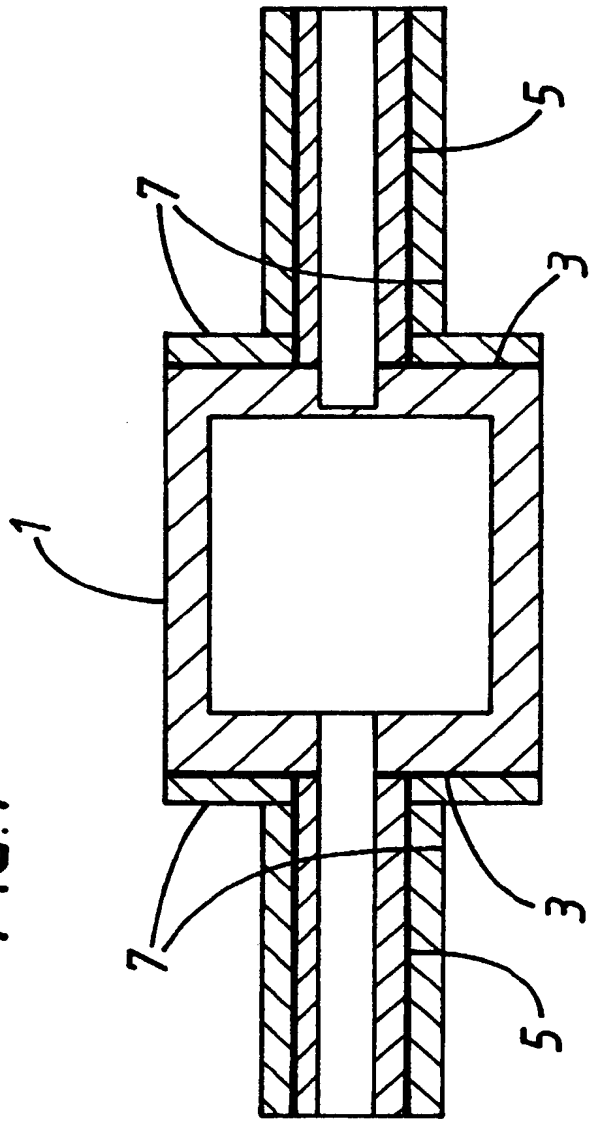


FIG.1

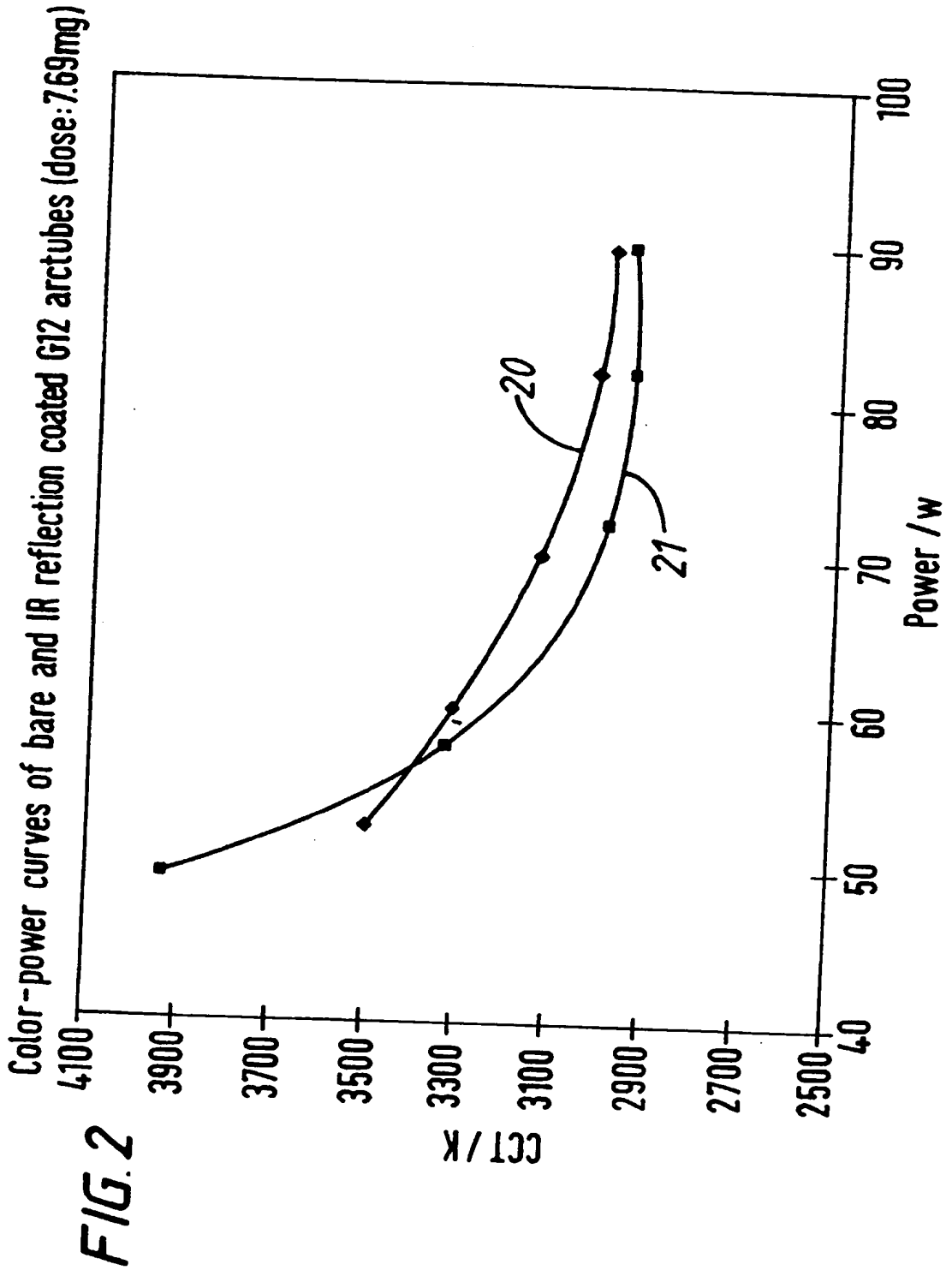
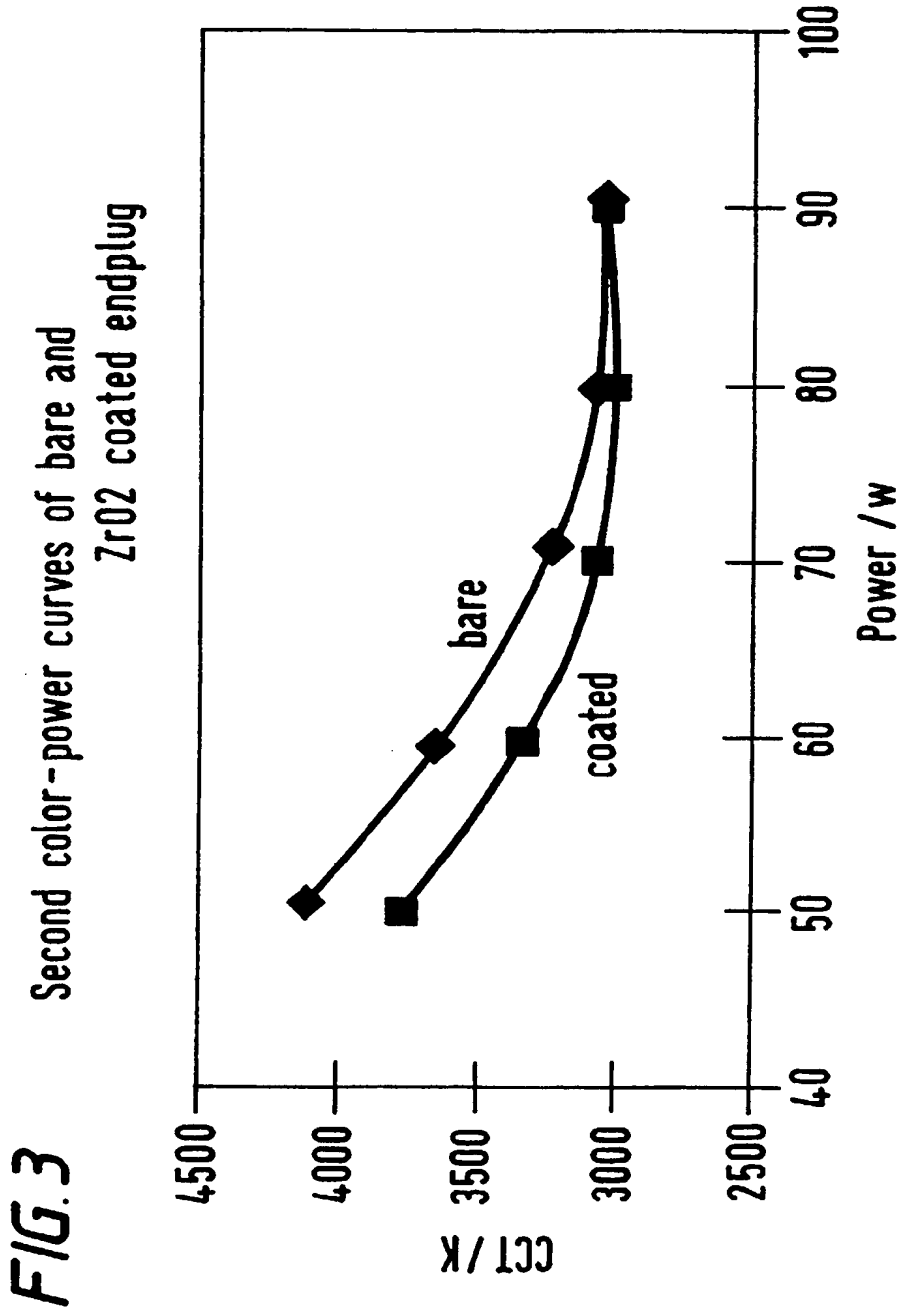


FIG. 2

FIG. 3


Second color-power curves of bare and ZrO2 coated endplug
CCT / K
4500
4000
3500
3000
2500
40
50
60
70
80
90
100
Power / w
bare
coated

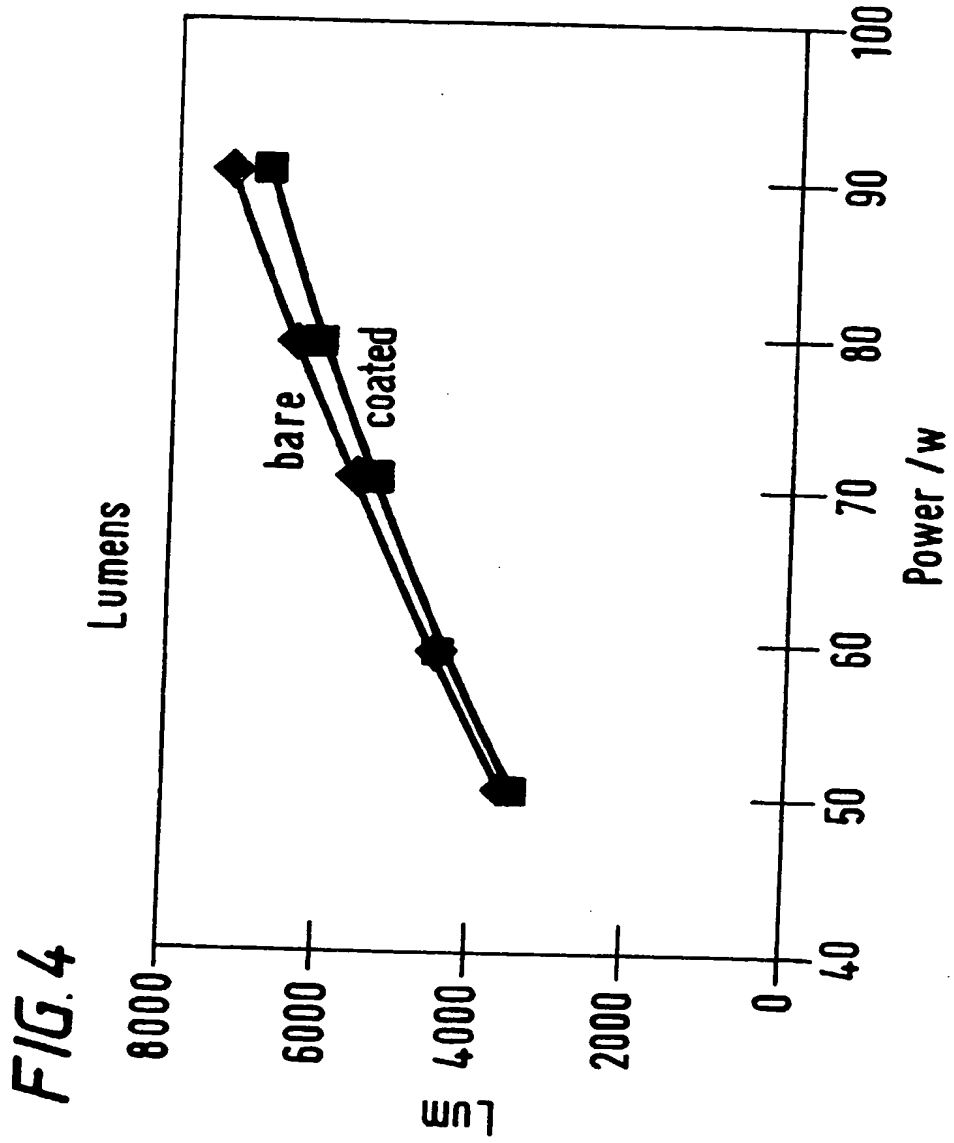


FIG. 4

GE 70W CMH CTQ_84 lamps - Vertical												15/01/97		
26 pellets (7.7mg metal halide)														
lamps at 100 hours - reference ballast at 220V														
CTQ_84 with zirconia coated legs														
No	V min	volts	amps	watts	p.f.	lumens	flicker	lm/W	V ext	x	y	mpcd	CCT	Ra
							%							
2	23.6	93.7	0.961	72.4	0.804	6320	1.8	87.3	180	0.4343	0.4091	2.05	3084	83
3	23.6	94.0	0.960	72.4	0.802	6400	2.0	88.4	177	0.4362	0.4084	0.76	3046	83
4	24.2	95.7	0.950	73.2	0.805	6580	1.9	89.9	182	0.4338	0.4080	1.88	3084	83
5	24.0	94.9	0.955	72.7	0.802	6390	1.8	87.9	182	0.4342	0.4071	1.30	3070	83
6	24.0	100.8	0.933	74.0	0.787	6380	1.7	86.2	194	0.4393	0.4044	2.94	2962	86
7	23.5	98.7	0.940	73.2	0.789	6060	1.1	82.8	190	0.4366	0.4060	0.65	3019	85
8	23.4	92.6	0.966	71.8	0.803	6170	1.6	85.9	181	0.4393	0.4067	2.10	2979	85
9	23.5	96.0	0.950	72.3	0.793	6420	1.8	88.8	186	0.4348	0.4045	0.93	3038	85
Ave	23.7	95.8	0.952	72.8	0.798	6340	1.7	87.2	184	0.4361	0.4068		3035	84
sd	0.3	2.7	0.011	0.7	0.007	160	0.3	2.2	6	0.0022	0.0017		46	1
												1.86		

FIG. 5a

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GE 70W CMH CTQ_84 lamps - Horizontal												16/01/97		
No	V min	volts	amps	watts	p.f.	lumens	flicker	lm/W	V ext	x	y	mpcd	CCT	Ra
							%							
2	23.6	102	0.92	73	0.78	6420	0.3	87.9	199	0.4377	0.4035	2.11	2981	83
3	23.4	104	0.92	73.7	0.77	6490	0.1	88.1	197	0.4382	0.4063	1.34	2994	83
4	24	104	0.91	73.9	0.78	6740	0.2	91.2	195	0.4342	0.4093	2.49	3087	83
5	23.5	102	0.92	74	0.79	6650	0.2	89.9	196	0.4317	0.4075	3.24	3116	83
6	23.8	105	0.91	73.3	0.77	6590	0.3	89.9	199	0.4366	0.4047	0.95	3010	86
7	23.6	108	0.9	72.9	0.75	6160	0.3	84.5	205	0.4368	0.4051	0.88	3009	85
8	23.2	101	0.93	72.9	0.78	6420	0.5	88.1	194	0.4353	0.4072	0.92	3051	84
9	24.1	106	0.91	73.9	0.77	6530	0.4	88.4	201	0.4374	0.4046	1.45	2995	85
Ave	23.7	104	0.92	73.5	0.77	6500	0.3	88.5	198	0.436	0.406		3030	84
sd	0.3	2.4	0.01	0.5	0.01	176	0.1	2	4	0.0022	0.0019		49	1
												1.98		

FIG. 5b

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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 2182

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 281 267 A (JOHNSON PETER D) 28 July 1981	1	H01J61/35
Y	* column 2, line 43 - column 2, line 49 * * column 3, line 8 - column 3, line 15 * * column 4, line 40 - column 4, line 44 * * column 4, line 56 - column 4, line 66 *	2-4	H01J61/30 H01J61/36
Y	EP 0 587 238 A (PHILIPS ELECTRONICS NV) 16 March 1994 * the whole document *	2-10	
Y	EP 0 602 927 A (GEN ELECTRIC) 22 June 1994 * column 6, line 2 - column 7, line 22 *	5-10	
A		11,12	
A	GB 2 036 420 A (THORN ELECTRICAL IND LTD) 25 June 1980 * page 1, line 20 - page 1, line 52 *	1-5	
A	US 3 374 377 A (COOK CLARENCE G) 19 March 1968 * column 1, line 24 - column 1, line 28 *	1-5	TECHNICAL FIELDS SEARCHED (Int.Cl.6) H01J
A	DE 26 34 533 A (GEN ELECTRIC) 10 February 1977 * page 9, paragraph 3 - page 10, paragraph 1 *	6-12	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	16 June 1998	Zuccatti, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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